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(71) Applicant: **MITSUBISHI DENKI KABUSHIKI KAISHA**
2-3, Marunouchi 2-chome Chiyoda-ku
Tokyo 100(JP)

(72) Inventor: **Kodai, Syojiro c/o Kitaitami Seisakusho of**
Mitsubishi Denki Kabushiki K. 1, Mizuhara 4-chome
Itami City Hyogo Prefecture(JP)
Inventor: **Ochi, Katsunori c/o Kitaitami Seisakusho of**
Mitsubishi Denki Kabushiki K. 1, Mizuhara 4-chome
Itami City Hyogo Prefecture(JP)

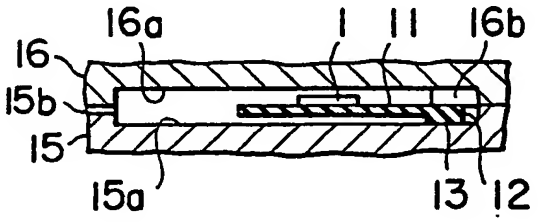
(74) Representative: **Lawson, David Glynne et al**
MARKS & CLERK 57-60 Lincoln's Inn Fields
London WC2A 3LS(GB)

(54) IC card.

(57) An IC card has a circuit board 11 with terminals 13 on one face at one end, and an IC module 1 on the other face. The terminals are on a portion 12 of the board which is raised above the surface of the rest of the board. Resin is injection molded round the circuit board and IC module so that these are completely incapsulated in resin on both sides to form a card body 14, with the exception of the raised terminal portion 12 and the terminals 13 on it.

To form the resin body 14, the circuit board and IC module are placed in a mold cavity in which they are located by means of the raised terminal portion 12 and narrow holding projections 16b while the rest of the circuit board and IC module are entirely surrounded by molding space. The holding projections 16b serve to form guide grooves 14a in the resin body 14.

FIG. 4A



EP 0 377 937 A2

IC CARD

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to an IC card formed by mounting an IC (Integrated Circuit) on a circuit board and molding them with resin.

DESCRIPTION OF THE RELATED ART

Fig. 1A is a plan view which illustrates a conventional IC card, and Fig. 1B is a cross-sectional view which illustrates the same. An integrated circuit 1 (abbreviated as "IC" hereinafter) is mounted on a reverse side of a circuit board 2 and connected to a circuit (not shown) formed on the same side of this circuit board 2. A plurality of electrode terminals 3 for establishing an electrical connection between the IC 1 and outer equipment is disposed at an end portion of the inverse side of the circuit board 2, that is, the obverse side of the same, these electrode terminals 3 are connected to the above circuit formed on the inverse side of the circuit board 2. Thus-formed circuit board 2 is fitted and bonded, with an adhesive (not shown), within a recessed portion formed in a card base body 4 composed of molding synthetic resin, such as to expose the obverse side of the circuit board. In an another method for assembling of the IC card, as shown in Figs. 2A and 2B, the thus-formed circuit board 2 is molded by sealing with resin as follows: first, the circuit board 2 is, as shown in Fig. 2A, disposed within a recessed portion 5a of the lower mold 5 such that the side on which the electrode terminal 3 is disposed is allowed to face downward and the two ends thereof are respectively supported by a pair of positioning projections 5b. Then, the circuit board 2 is fixed within the recessed portion 5a by reducing pressure through a suction hole 5c. Next, as shown in Fig. 2B, an upper mold 6 is secured to the lower mold 5. Then, molten synthetic resin is introduced through a runner 5d and injected into the recessed portions 5a and 6a. Thus, as shown in Fig. 1, an IC card in which the circuit board 2 is embedded in the card base body 4 as to be integrated with the latter and the obverse side of the circuit substrate 2 is allowed to appear.

In the conventional IC card formed as described above, a problem rises in the type of an IC card formed by adhering the circuit board 2 to which the IC 1 is secured to the reverse side of this circuit board 2 to the recessed portion in the card base body 4 which has been previously molded, the problem being such as a deterioration of the adhesion and water invasion from outside to the adhered portion. On the other hand, an IC card formed by integrally embedding the one side of the circuit board 2 with synthetic resin rises a problem in that the circuit board 2 cannot be readily secured to the mold. In addition, a large portion of one surface of the IC card 1 is covered with the obverse surface of the circuit board 2, which deteriorates the quality in terms of appearance of the IC card. It as well causes a problem in that it is difficult to apply a print or the like to the surface, and causes a limitation in terms of design of the IC card. Another problem rises, due to the fact that the surface of the circuit board 2 is allowed to appear on one surface of the card base body 4, in that the card can be warped due to the difference between the thermal expansion coefficients of the circuit board 2 and the card base body 4. As a result, a bond strength between the circuit board 2 and the body 4 deteriorates.

SUMMARY OF THE INVENTION

In view of the above-described problems of the conventional IC card, an object of the present invention is to provide an IC card exhibiting advantages that the circuit board can be readily embedded in the card base, further the circuit board does not appear outside of the IC card, any warp of the card can be prevented, a reliability thereof can be improved, any limitation in terms of designing the IC card can be suspended, and the quality of appearance the IC card can be improved.

A still further object of the present invention is to provide an apparatus for and a method of manufacturing an IC card of the type described above.

According to the present invention, a surface of a terminal board portion project over one side of a circuit board, the surface of the terminal board portion is placed on a bottom surface of a recessed portion of a lower mold, the terminal board portion is held by at least a pair of holding projections formed in a recessed portion of an upper mold from the reverse side thereof as to secure the circuit board portion such that the other end portion of the circuit board is floated in a recessed portions of the upper and the lower molds, and the circuit board portion is embedded by injecting synthetic resin. As a result, the IC card having a card base

body wherein electrode terminal portion is only allowed to appear on one surface of the IC card is formed. The at least a pair of pressing projections of the upper mold forms at least a pair of guide grooves at one end portions of the card base body.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1A is a plan view which illustrates a conventional IC card;

Fig. 1B is a sectional view taken along line IB-IB in Fig. 1A;

Fig. 2A is a broken side sectional view which illustrates a state where a circuit board is disposed in a lower mold;

Fig. 2B is a broken side sectional view which illustrates a state where an upper mold is secured to the lower mold shown in Fig. 2A;

Fig. 3A is plan view which illustrate an IC card according to the present invention;

Fig. 3B is a sectional view taken along line IIIB-IIIB in Fig. 3A;

Fig. 3C is a front elevational view which illustrates the IC card shown in Fig. 3A;

Fig. 4A is a broken side sectional view which illustrates a state where the circuit board is secured within the mold;

Fig. 4B is a broken front sectional view which illustrates a state where the circuit board is secured within the mold;

Fig. 5A is a broken plan view of a circuit board according to another embodiment of the present invention;

Fig. 5B is a sectional view taken along line VB-VB in Fig. 5A;

Fig. 6 is a broken front sectional view which illustrates a state where the circuit substrate shown in Fig. 5A is secured within the mold; and

Fig. 7 is a broken front sectional view which illustrates an essential portion of the IC card whose card base body has been molded by a mold.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Figs. 3A to 3C are views which illustrate an embodiment of an IC card according to the present invention. Referring to the drawings, a terminal board portion 12 is integrally formed or adhered on an end portion of a circuit board 11 as to become higher than the level of the surface of the circuit board 11. On surface of the terminal substrate portion 12, a plurality of electrode terminals 13 for establishing connections with the outside of the IC card are formed, the plurality of electrode terminals 13 is connected to a circuit (not shown) which is on the reverse side of the circuit board 11. An IC 1 which is connected to the circuit is mounted on the other side, that is, a reverse side of the circuit board 11. A card base body 14 is formed by integrating and embedding the IC 1 and the circuit board 11 by means of injection-molding with synthetic resin after, wherein only the electrode terminal portion 13 of the terminal board portion 12 is allowed to appear the outside of the IC card. A pair of guide grooves 14a having a depth starting from the reverse side of the card base body 14 to the reverse surface of the terminal board portion 12 are formed at the end portions of this card base body 14, and these grooves 14a extend in the direction of insertion and withdrawal of the IC card. This pair of guide grooves 14a are formed by molding by using a mold and capable of preventing erroneous insertion of the IC card inside out into the external equipment.

The above-described card base body 14 is molded as shown in Figs. 4A and 4B. The circuit board 11 which the IC 1 is mounted is put in the bottom portion of a recessed portion 15a of a lower mold 15 so as to allow the electrode terminal 13 to face downward. Then an upper mold 16 is secured to the lower mold 15. As a result, the terminal board portion 12 is pressed down from the reverse side by a pair of pressing projections 16b formed on the both sides of the recessed portion 16a in the upper mold 16. Consequently, the circuit board 11 is held such that the other end portion of the board 11 is floated between the two recessed portions 15a and 16a. Then, the molten synthetic resin is injected through a runner 15b into the two recessed portions 15a and 16a and the mold device is cooled down thereafter. As the result, a card base body 14 which embeds the circuit board 11 so as to allow only the portion of the electrode terminals 13 to appear on the IC card surface can be formed, and an IC card shown in Fig. 3A can be obtained. The guide grooves 14a are formed in the card base body 14 by means of the holding projections 16b of the upper mold 16.

Figs. 5A and 5B are vies which illustrate a circuit board portion of an IC card according to a second embodiment of the present invention. The IC 1 is mounted on the reverse side of the circuit board 11, while an injected terminal board portion 12 is integrally formed or adhered on an end portion of the obverse side of the circuit board 11. A plurality of electrode terminals 13 are formed on the terminal board portion 12, and a pair of positioning through holes 12a are formed on the both sides of the terminal board portion 12. Thus-fashioned circuit board 11, as shown in Fig. 6, is disposed within the recessed portions 15a and 16a in the upper and lower molds 15 and 16 respec-

tively. In the mold device, the portion of the terminal board 12 is held and secured between the bottom surface of the recessed portion 15a and the holding projection 16b. A pair of positioning pin portions 15c which corresponds to the positioning holes 12a are formed on the both sides of the recessed portion 15a of the lower mold 15 as to be inserted into the positioning holes 12a to position the circuit board 11. Then the molten synthetic resin for molding is injected through a runner (see Fig. 4A) into the recessed portions 15a and 16a in the upper and lower molds 15 and 16, and the mold device is cool down thereafter. As the result, a card base body 14 can be formed so that an IC card can be manufactured, this card base body 14 being formed such that only a portion of the terminal electrodes 13 is allowed to appear on the IC card surface and the portion including the circuit board 11 is embedded in the body 14. The positioning pin portions 15c are formed conically and arranged to be lower than the thickness of the terminal board 12 so that synthetic resin can be introduced into a portion of the positioning hole 12a. As a result, the circuit board 11 can be strongly secured to the card base body 14 by injection molding with the synthetic resin.

In the above-described embodiments, although the pair of holding projections 16b are disposed on the both sides of the upper mold 16 to form the pair of guide grooves 14a, the number of the projections, that is the number of the guide grooves, may be increased.

As described above and according to the present invention, the terminal board portion is disposed at an end portion of the circuit board to project the surface of the terminal portion over the surface of this circuit board, the electrode terminals are formed on the surface of the terminal board portion, the circuit board portion which provides the IC module on the reverse side thereof is embedded in the card base body by molding with the synthetic resin, and thereby only the electrode terminal portion is allowed to appear. Consequently, the circuit board does not appear outside of the IC card, any warp of the card can be prevented, its reliability can be improved, any limitation in terms of design of the IC card can be suspended, and the quality of appearance can be improved.

At least a pair of guide grooves are formed which has the depth starting from the reverse side of the card base body to the reverse side of the terminal board portion and extends in the insertion direction of the IC card, the guide grooves being disposed at both end portions of the card base body. These guide grooves are formed by the holding projections formed in the upper mold. Since the thus-formed holding projections press down the reverse side of the terminal board disposed on the bottom surface of the recessed portion of the lower mold, they can also be used as means for securing the circuit board portion disposed in the mold. As a result, the structure of the securing means can be simplified with respect to that of the conventional securing means, and required works for securing the circuit board portion can be conducted easily.

In addition, the structure may be so arranged that a pair of positioning holes are formed on the both sides of the terminal board portion surface of the circuit board, and positioning pins each having a length shorter than the thickness of the corresponding positioning holes are formed for the purpose introducing the synthetic resin for the card base body into a part portion of the positioning holes at the time of the injection molding by using the synthetic resin. As a result, positioning of the circuit board portion can be conducted easily and the coupling of this circuit substrate portion with the card base body can be conducted strongly.

Claims

1. An IC card comprising:
a circuit board (11) including a terminal board portion (12) disposed at an end portion thereof on one side thereof, an IC module (1) being mounted on the other side thereof,
at least one electrode terminal (13) on the surface of said terminal board portion and connected to said IC, and
a card base body (14) in which said circuit board is embedded by molding by using a synthetic resin with said electrode terminal portion appearing on the outside of said IC card,
characterized in that the terminal portion (12) stands above the surface of the said one side of the circuit board (11) and both sides of the circuit board are embedded in the molded resin with the terminal portion (12) remaining exposed.

2. An IC card according to claim 1 further comprising a pair of guide grooves (14a) disposed at two ends of said card base body and having a depth starting from the other side of said card base body to a reverse side of said terminal board portion in the direction in which said IC card is inserted.

3. An IC card according to claim 2, wherein at least a pair of positioning through holes (12a) starting from the surface of said terminal board portion of said circuit board to the reverse side of said portion are formed at the two ends of said terminal board portion of said circuit board, said resin forming said card base body is introduced into a part portion of said positioning holes respectively.

4. An apparatus for manufacturing an IC card

comprising:
a lower mold (15) including a recess (15a) having a bottom portion for disposing a circuit board (11) having terminal board portion (12) disposed at an end portion of said circuit board as to project over one side of said circuit board, an IC module (1) being mounted on the other side of said board substrate;
an upper mold (16) including a recess (16a) therein in which at least a pair of holding projections (16b) are provided at the both side thereof, said holding projections holding said terminal board portion (12) of said circuit board from the reverse side thereof so as to keep the other end of said circuit board to float in said two recesses when said upper mold is secured to said lower mold such that said recesses of said lower and upper molds confront each other, and said upper mold being to serve as a mold for forming a guide groove (14a); and
a runner (15b) formed when said upper mold is secured to said lower mold and through which molten synthetic resin is injected into said recesses.

5. An apparatus according to claim 4, wherein said terminal board portion of said circuit board includes at least a pair of positioning through holes (12a) starting from an obverse side to the reverse side thereof at the two sides thereof, and at least a pair of positioning pin portions (15c) each having a length shorter than that of said positioning holes and into which said positioning holes are inserted are formed in the bottom portion of said recess of said lower mold.

6. A method of making an IC card, comprising providing a circuit board (11) with a terminal portion (12) at an end thereof on one surface of the circuit board and raised above the said one surface, mounting an IC module (1) on the other surface of the circuit board (11), placing the circuit board and IC module in a mold cavity with the raised terminal portion (12) in contact with a mold surface and the rest of the circuit board and IC module spaced from the walls of the mold cavity, and molding an insulating resin material around the circuit board and IC module in the mold cavity.

7. A method of manufacturing an IC card according to claim 2 which is arranged such that said circuit board (11) is embedded in said card base body (14) with said electrode terminal portion (12) of said terminal board portion allowed to appear outside of said IC card, guide grooves (14a) extending in the insertion direction of said IC card are formed at one end of the reverse side of said card base body, said method being further arranged that a mold is used consisting of a lower mold (15) having a recessed portion (15a) and an upper mold (16) including a recessed portion (16a) and provided with at least a pair of holding projections (16b) at the both sides of said recessed portion capable of holding said terminal board portion of said circuit board from the reverse side of said terminal board portion and serving as molds for forming said guide grooves, and said method comprising:
a step in which said circuit board is placed on the bottom portion of said recessed portion of said lower mold so as to face said electrode terminal portion of said terminal board portion downwards;
a step in which said upper mold is secured to said lower mold for the purpose of holding said circuit board such that the other end portions of said circuit board is floated from said two recessed portions as a result of pressing down of said terminal board portion by holding projections of said upper mold from the reverse side of said terminal board portion disposed at an end portion of said circuit board, and for the purpose of forming a guide groove extending in the insertion direction of said IC card at one end portion of the other side of said card base body;
a step in which molten synthetic resin is injected into a molding space formed by securing said upper mold to said lower mold; and
a step in which said molding space is cooled down.

8. A method of manufacturing an IC card according to claim 3 which is arranged such that said circuit board (11) is embedded in said card base body (14) with said electrode terminal portion (12) of said terminal board portion allowed to appear outside of said IC card, guide grooves (14a) extending in the insertion direction of said IC card are formed at one end of the reverse side of said card base body, and said terminal board portion of said circuit board includes at least a pair of positioning through holes (12a) starting from the obverse side thereof to the reverse side at the both sides thereof, said method being further arranged that a mold consisting of a lower mold (15) and an upper mold (16) is used; said lower mold having a recessed portion in which at least a pair of positioning pins (15c) having a length shorter than said positioning holes formed in said terminal board portion and inserting into said positioning holes, and said upper mold including a recessed portion and being provided with at least a pair of holding projections (16b) at the both sides of said recessed portion capable of holding said terminal board portion of said circuit board from the reverse side of said terminal board portion and serving as molds for forming said guide grooves, and said method comprising:
a step in which said circuit board is placed on the bottom portion of said recessed portion of said lower mold so as to face said electrode terminal portion of said terminal board portion to downward with inserting said positioning pin portions into said

positioning holes;
a step in which said upper mold is secured to said lower mold for the purpose of holding said circuit board such that the other end portions of said circuit board is floated from said two recessed portions as a result of pressing down of said terminal board portion by holding projections of said upper mold from the reverse side of said terminal board portion disposed at an end portion of said circuit board and for the purpose of forming a guide groove extending in the insertion direction of said IC card at one end portion of the other side of said card base body;
a step in which molten synthetic resin is injected into said molding space formed by securing said upper mold to said lower mold; and
a step in which said molding space is cooled down.

9. An IC card, substantially as herein described with reference to Figures 3a to 4b or Figures 5a to 7 of the accompanying drawings.

10. Apparatus for making an IC card, substantially as herein described with reference to Figures 3a to 4b or Figures 5a to 7 of the accompanying drawings.

11. A method of making an IC card, substantially as herein described with reference to Figures 3a to 4b or Figures 5a to 7 of the accompanying drawings.

FIG. 1A
PRIOR ART

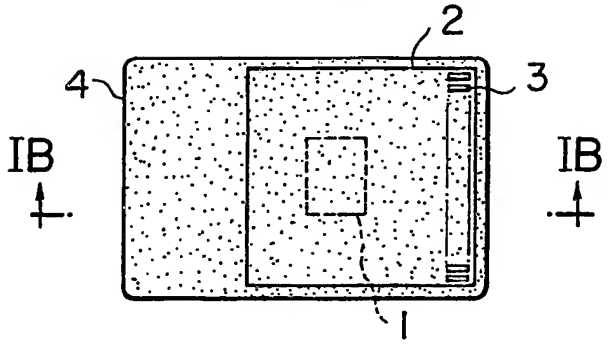


FIG. 1B
PRIOR ART

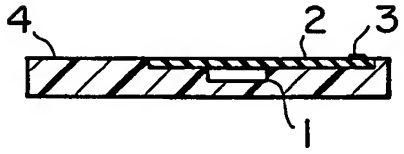


FIG. 2A
PRIOR ART

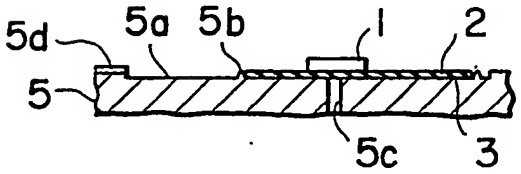


FIG. 2B
PRIOR ART

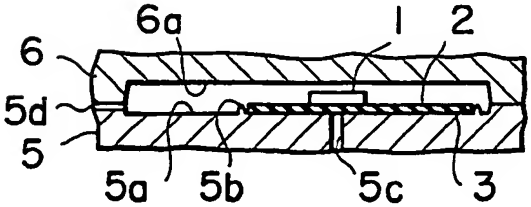


FIG. 3A

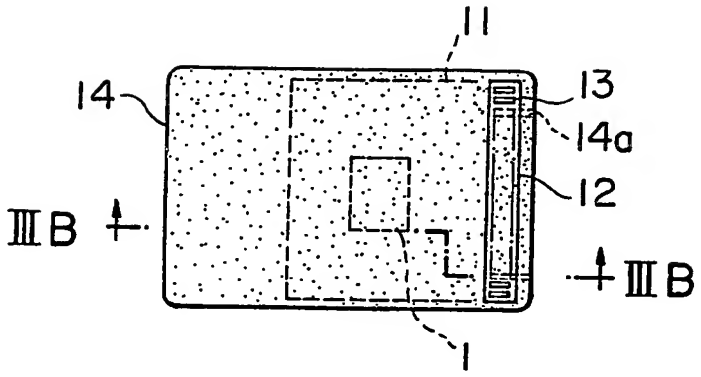


FIG. 3B

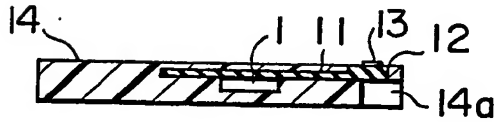


FIG. 3C

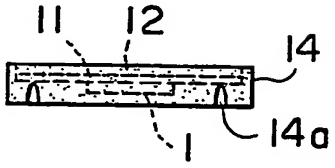


FIG. 4A

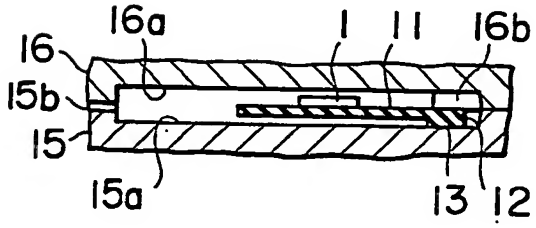


FIG. 4B

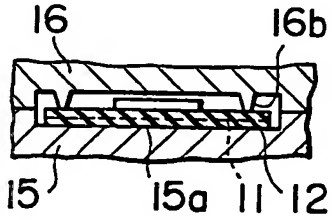


FIG. 5A

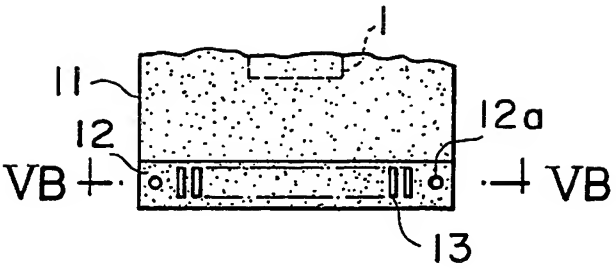


FIG. 5B

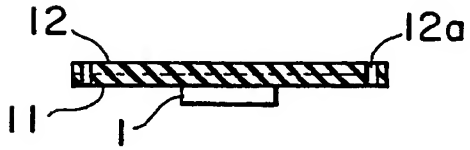


FIG. 6

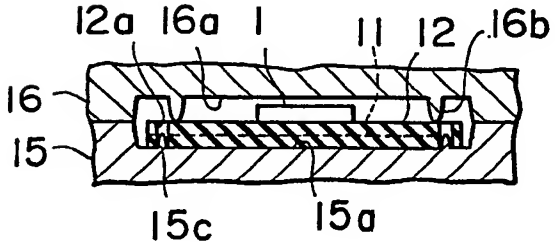
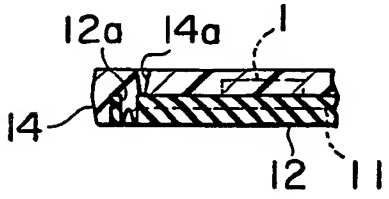


FIG. 7



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(71) Applicant: MITSUBISHI DENKI KABUSHIKI KAISHA
2-3, Marunouchi 2-chome Chiyoda-ku
Tokyo 100(JP)

(72) Inventor: Kodai, Syojiro c/o Kitaitami Seisakusho of
Mitsubishi Denki Kabushiki K. 1, Mizuhara 4-chome
Itami City Hyogo Prefecture(JP)
Inventor: Ochi, Katsunori c/o Kitaitami Seisakusho of
Mitsubishi Denki Kabushiki K. 1, Mizuhara 4-chome
Itami City Hyogo Prefecture(JP)

(74) Representative: Lawson, David Glynne et al
MARKS & CLERK 57-60 Lincoln's Inn Fields
London WC2A 3LS(GB)

(54) **IC card.**

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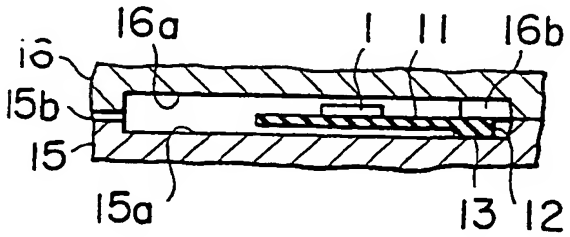
To form the resin body 14, the circuit board and IC module are placed in a mold cavity in which they are located by means of the raised terminal portion 12 and narrow holding projections 16b while the rest of the circuit board and IC module are entirely surrounded by molding space. The holding projections 16b serve to form guide grooves 14a in the resin body 14.

FIG. 4A



EP 0 377 937 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 30 8199

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X,A	EP-A-0 254 444 (HITACHI) * column 3, line 51 - column 7, line 26; figures 3-7 *	1,6,4	G 06 K 19/07
Y	EP-A-0 297 991 (BULL) * column 3, line 43 - column 6, line 65; figures 1-5 *	1-8	
Y	EP-A-0 277 854 (SCHLUMBERGER) * column 3, line 37 - column 8, line 5; figures 1-5 *	1-8	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

G 06 K

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	02 May 91	FORLEN G.A.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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T: theory or principle underlying the invention

E: earlier patent document, but published on, or after the filing date
D: document cited in the application
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